BASF Chemical Emergency Medical Guidelines

Hydrazine (NH_2-NH_2) C 1

Information and recommendations for doctors at hospitals/emergency departments

- **Patients exposed only to hydrazine vapor do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with hydrazine liquid can secondarily contaminate rescue and medical personnel by direct contact or through off-gassing hydrazine.**
- **Hydrazine vapor or liquid is irritating and can cause corrosive burns to eyes or skin.**
- **Inhalation of the vapor can result in rhinorrhea, coughing, and dyspnea. Laryngospasm and signs of pulmonary edema (shortness of breath, cyanosis, expectoration, coughing) may occur.**
- **Systemic toxicity comprises of nausea, vomiting, abdominal pain, CNS depression, trembling, ataxia, seizure, and methemoglobinemia.**
- **Treatment consists of symptomatic and supportive measures. In case of neurological symptoms, pyridoxine can be used as antidote. Treat symptomatic methemoglobinemia with toluidine blue/methylene blue.**

1. Substance information

Hydrazine (NH_2-NH_2), CAS 302-01-2
Hydrazine hydrate (N_2H_4-H_2O), CAS 10217-52-4
(contains 55% Hydrazine w/w); CAS 7803-57-8 (contains 64% Hydrazine w/w)
Synonymes: diamide, diamine
Hydrazine is at room temperature a colorless, fuming, oily liquid with an ammonia-like or fishy odor. The substance decomposes producing ammonia fumes, hydrogen and nitrogen oxides, causing fire and explosion hazard (boiling point 113.5 °C, flash point 37.8 °C).
Hydrazine has been used as a rocket fuel, for corrosion prevention, as chemical reactant, and in the urethane coating production.

2. Routes of exposure

Inhalation

Inhalation is a significant route of exposure. Hydrazine's odor and irritant properties may provide adequate warning of hazardous concentrations. Swelling of the throat and signs of pulmonary edema (shortness of breath, cyanosis, expectoration, coughing) may occur.

Skin/eye contact

Rapid and significant absorption may occur. **Direct contact with liquid hydrazine or concentrated vapor on skin or eyes causes irritation/chemical burns. Hypersensitivity reactions have also been reported with dermal exposures.**

Ingestion

Accidental ingestion of hydrazine is unlikely. Hydrazine solutions may cause corrosive injury to the mouth, throat, and stomach if ingested.

3. Acute health effects

Hydrazine exposure usually causes eye and nose irritation. Breathing hydrazine for short periods may cause coughing and irritation of the throat and lungs, convulsions, tremors, seizure, or methemoglobinemia. Breathing hydrazine for long periods may cause liver and kidney damage. Hydrazine is a sensitizer and a suspected carcinogen.

C 2

Dose-effect relationships Dose-effect relationships are as follows:

Hydrazine concentration		Limit Values	
1 ppm	-	PEL-TWA (OSHA)	
3 - 4 ppm	-	Odor detection	
50 ppm	-	IDLH (NIOSH)	
AEGL1	10 min	0,1ppm	30 min 0,1 ppm
AEGL2	10 min	23 ppm	30 min 16 ppm
AEGL3	10 min	64ppm	30 min 45 ppm

Potential sequelae For most exposed individuals symptoms will resolve over several weeks or months. Survivors of severe inhalation injury, especially if chest x-ray and pulmonary function abnormalities are associated, may suffer residual chronic lung disease. Hydrazine is a sensitizer and a carcinogen.

4. Actions

Self-protection Patients exposed only to hydrazine vapor do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with hydrazine can secondarily contaminate other people by direct contact or through off-gassing hydrazine.

Decontamination Patients exposed only to hydrazine vapor who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination. Hydrazine can spontaneously ignite upon contact with cloth; clothing should be removed immediately.
Patients who are able and cooperative may assist with their own decontamination. If the exposure involved liquid hydrazine and if clothing is contaminated, remove and double-bag the clothing.
Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 20 minutes, and that the pH of the conjunctival fluid has returned to normal (7.0). If not, continue eye irrigation during other basic care and transport. If eye irrigation is impaired by blepharospasm, one to two drops of oxybuprocaine 0.4% may be instilled into affected eyes to allow adequate irrigation. Remove contact lenses if present and easily removable without additional trauma to the eye.
Assure that exposed skin and hair have been flushed with plain water for at least 15 minutes. If not, continue flushing during other basic care and transport. Protect eyes during flushing of skin and hair.

Initial treatment **The following measures are recommended if the exposure concentration is 1 ppm or greater and if symptoms, e. g. eye irritation or pulmonary symptoms, have developed:**

- **Administration of oxygen**
- **Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.**

Patients with severe clinical respiratory symptoms (e.g. bronchospasms, stridor) should be treated as follows:
a) Nebulization of adrenaline (epinephrine): 2 mg adrenaline (2 ml) with 3 ml NaCl 0.9% and inhale through a nebulizer mask.

b) Administration of a ß2-selective adrenoceptor agonist, e.g., four strokes of terbutaline or salbutamol or fenoterol (one stroke usually contains 0.25 mg of terbutaline sulfate; or 0.1 mg of salbutamol; or 0.2 mg of fenoterol); this may be repeated once after 10 minutes. Alternatively, 2.5 mg salbutamol and 0.5 mg atrovent may be administered by nebulizer mask.

If inhalation is not possible, administration of terbutaline sulfate (0.25 mg to 0.5 mg) subcutaneously or salbutamol (0.2 mg to 0.4 mg over 15 minutes) intravenously.

c) Intravenous administration of 250 mg methylprednisolone (or equivalent steroid dose).

Patients with clinical signs of a toxic lung edema (e.g. foamy sputum, wet crackles) should be treated as follows:

a) Start CPAP-therapy (Continuous Positive Airway Pressure Ventilation).
b) Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose) is recommended

Note: Efficacy of corticosteroid administration has not yet been proven in controlled clinical studies.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.
If hydrazine has been in contact with the skin, chemical burns may result; treat as thermal burns: adequate fluid resuscitation and administration of analgesics, maintenance of the body temperature, covering of the burn with a sterile pad or clean sheet. If contact of the skin with liquid hydrazine under pressure has occurred, evaluate for the presence of frostbite.
After eye exposure chemical burns may result; treat as thermal burns. Immediately consult an ophthalmologist.
Note: Any facial exposure to liquid hydrazine should be considered as a serious exposure.

Antidotal treatment

In case of neurological symptoms: Initially, establishment of intravenous access and intravenous administration of pyridoxine (vitamin B6) over 5 to 10 minutes (25 mg/kg body weight).
Pyridoxine 25 mg/kg IM or IV given in conjunction with a benzodiazepine has been advocated for treating seizure, CNS depression, and lactic acidosis associated with hydrazine exposure. Repeat as necessary, until up to 5 g per day of pyridoxine has been given. Adverse effects in acute dosing are rare. CNS depression may occur if greater than 5 g per day of pyridoxine is given using 1 mL vials due to the presence of the diluent chlorobutanol.
Maintain the patient at the hospital/emergency department.
Treat symptomatic methemoglobinemia with toluidine blue or methylene blue, if G-6-PD deficiency is not present. Toluidine blue dosage is 2 to 4 mg/kg intravenously over 5 minutes. Dose may be repeated in 30 minutes. Methylene blue dosage is 1 mg/kg IV over 5 to 30 minutes; a repeat dose of up to 1 mg/kg may be repeated in 1 hour. Dosage should be repeated if methemoglobin levels remain greater than 30% or if signs and symptoms persist.

Further evaluation and treatment

To the standard intake history, physical examination, and vital signs add pulse oximetry monitoring and a PA chest X-ray.
Spirometry should be performed. Routine laboratory studies should include a complete blood count, blood glucose, pH, methemoglobin, lactate, renal function, liver enzyme. and electrolyte determinations.
Evidence of pulmonary edema - hilar enlargement and ill-defined, central-patch infiltrates on chest radiography - **is a late finding that may**

occur 6 to 8 hours or later after exposure. The chest X-ray is typically normal on first presentation to the emergency department even with severe exposures.
Patients who have been exposed to a concentration of 50 ppm or greater, or who develop serious signs or symptoms, should be observed for a minimum of 24 hours and reexamined frequently.
Delayed effects are unlikely in patients who have minor upper respiratory symptoms (mild burning or a slight cough) that resolve quickly.
If oxygen saturation is less than 90 % or if it appears to drop, immediately check arterial blood gases and repeat the chest X-ray.
If blood gasses begin to show deterioration and/or if the chest X-ray begins to show pulmonary edema start oxygen supplementation.
In case of worsening clinical signs (especially tachypnea >30/min with a simultaneous decrease of the partial pressure of carbon dioxide) CPAP-therapy (Continuous Positive Airway Pressure Ventilation) should be started within the first 24 hours after exposure.
In case of a pulmonary edema fluid intake/output and electrolytes should be monitored closely. Avoid net positive fluid balance. Central line or Swan-Ganz catheterization might be considered, to optimize fluid management.
As long as signs of pulmonary edema are present, intravenous administration of methylprednisolone (or an equivalent steroid) should be continued in intervals of 8-12 hours.

Prophylactic antibiotics are not routinely recommended but may be used based on the results of sputum cultures. Pneumonia can complicate severe pulmonary edema.
Treat patients who have bronchospasms with aerosolized bronchodilators, i.e. terbutaline or salbutamol.

Patient release/ follow-up instructions

Clinically asymptomatic patients exposed to a concentration of **less than 1 ppm** (depending on the period of time exposed) **as well as patients who have a normal clinical examination and no signs or symptoms of toxicity may be discharged after an appropriate observation period in the following circumstances:**

a) The evaluating physician is experienced in the evaluation of individuals with hydrazine exposure.
b) Information and recommendations for patients with follow-up instructions are provided verbally and in writing. Patients are advised to seek medical care promptly if symptoms develop or recur.
c) The physician is comfortable that the patient understands the health effects of hydrazine.
d) Site medical is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release from the emergency department.
e) Heavy physical work should be precluded for 24 hours.
f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.

Patients who have eye or serious skin injuries should be reexamined in 24 hours.
Post discharge spirometry should be repeated until values return to the patient’s baseline values.

In this document BASF has made a diligent effort to ensure the accuracy and currency of the information presented but makes no claim that the document comprehensively addresses all possible situations related to this topic. This document is intended as an additional resource for doctors at hospitals/emergency departments in assessing the condition and managing the treatment of patients exposed to hydrazine. It is not, however, a substitute for the professional judgement of a doctor and must be interpreted in the light of specific information regarding the patient available to such a doctor and in conjunction with other sources of authority.

BASF SE
Corporate Health Management
Carl-Bosch-Straße 38
67056 Ludwigshafen
Germany

BASF Corporation
Medical Department
100 Park Avenue
Florham Park, NJ 07932
USA

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